Network Programming

Introduction

The Computer Network

➢ A **computer network** is a group of computers/devices(Nodes) that use a set of common communication protocols over digital interconnections for the purpose of sharing resources located on or provided by the network nodes.
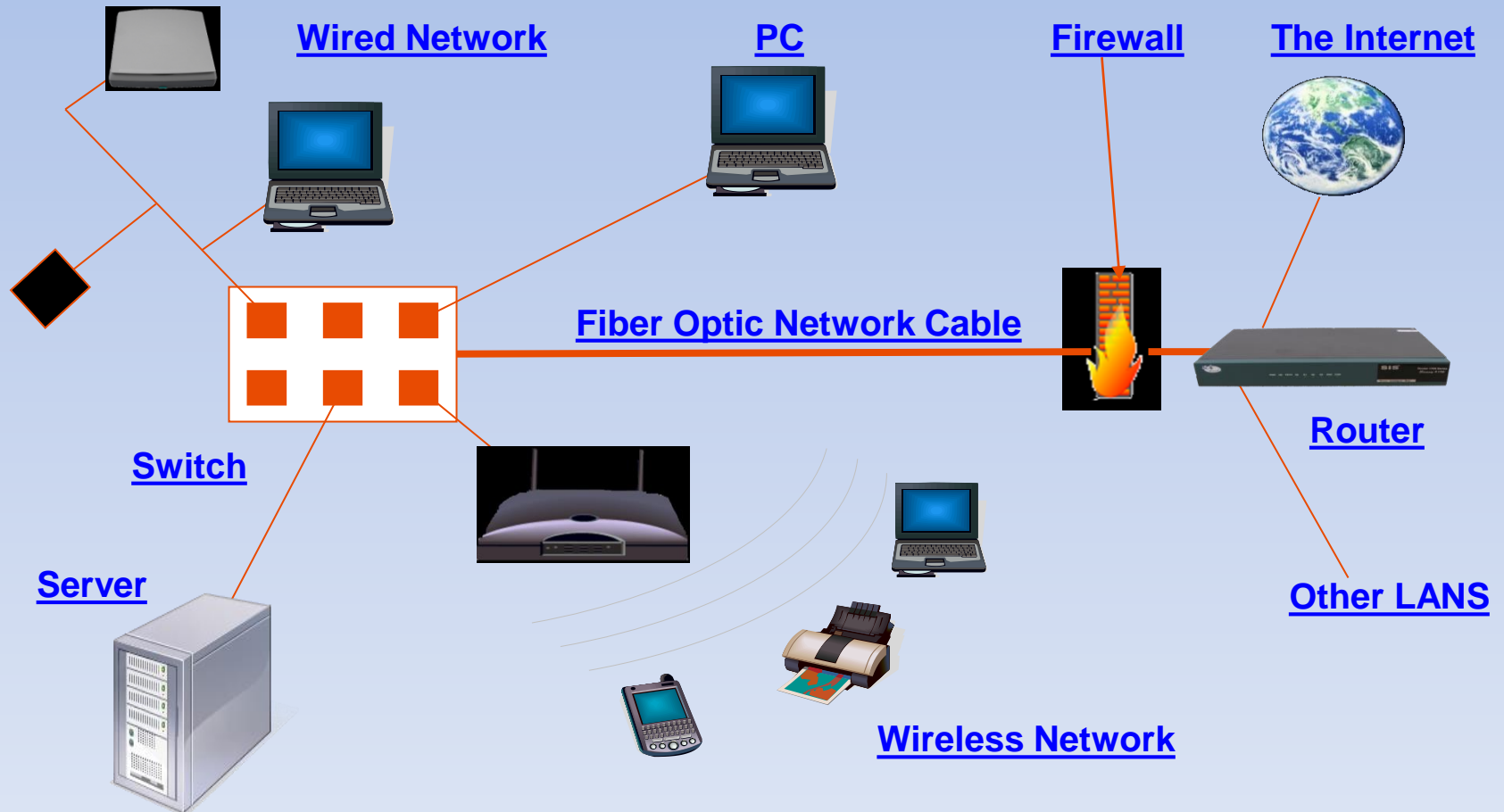
The Computer Network

➤ The **nodes** of a computer network may include personal computers, servers, networking hardware, or other specialised or general-purpose hosts.

➤ Devices connected to the Internet are called **hosts**.

➤ Most hosts are **computers**, but hosts also include routers, printers, fax machines, soda machines, bat houses, etc.

The Computer Network

➢ The **interconnections** between **nodes** are formed from a broad spectrum of telecommunication network technologies, based on physically wired, optical, and wireless technologies.

➢ A **communication protocol** is a set of rules for exchanging information over a network.

The Network Diagram

Wired Network

PC

Firewall

The Internet

Fiber Optic Network Cable

Switch

Router

Server

Other LANS

Wireless Network

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Why do we care about network concepts?

We need to understand what we are working with.

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Terms in Computer Network

- LAN

- WAN

- Internet

- WiFi

Computer Network

- What is a hub?

- A switch?

- A router?

- A WAP?

Network layers

➢ The concept of network layers is a **framework** that helps to understand complex network interactions.

➢ There are two models that are widely referenced today:
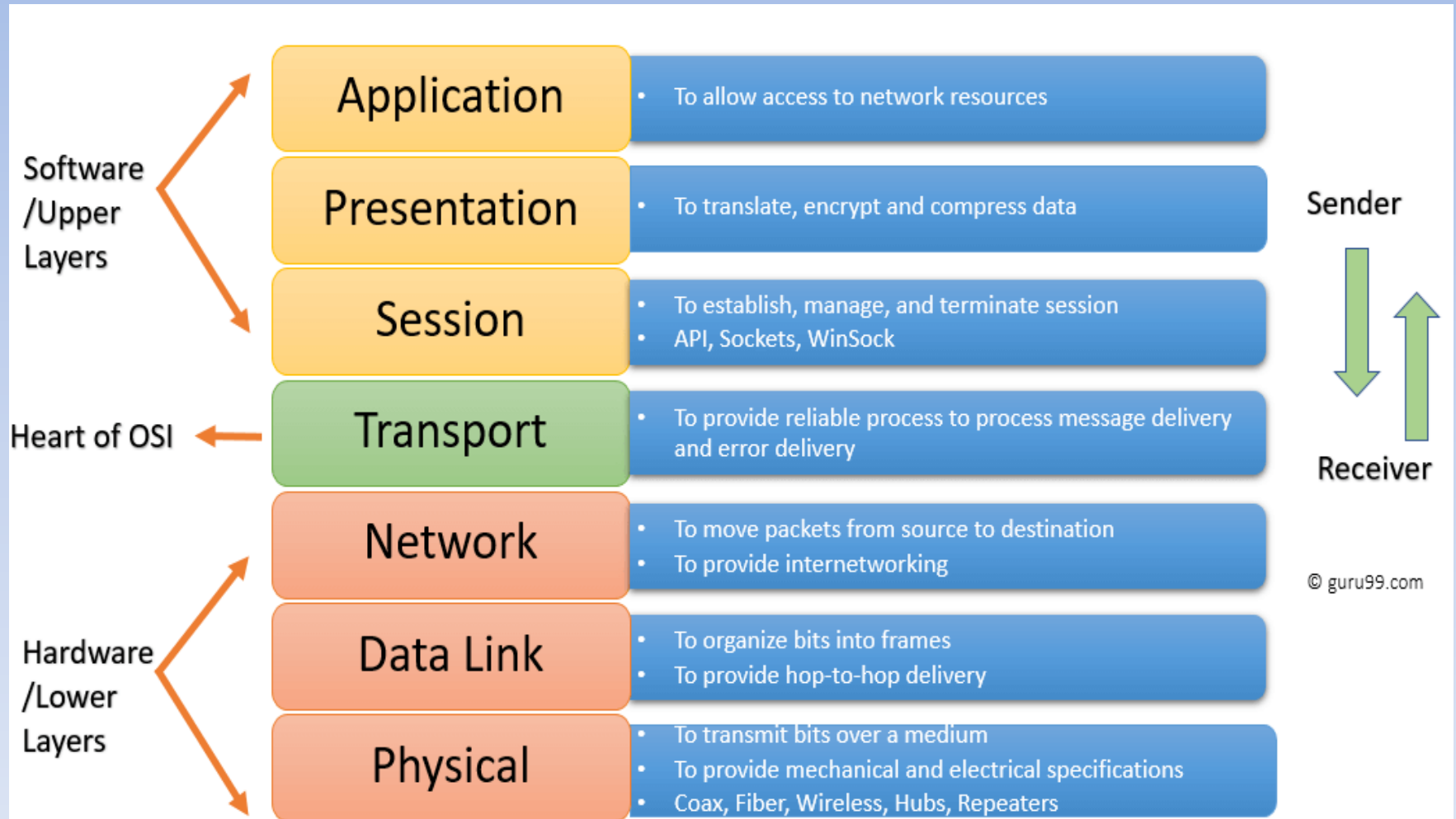
✓ **OSI** and **TCP/IP**.

What is OSI Model?

➢ The OSI Model is a **logical** and **conceptual** model that defines network communication used by systems open to interconnection and communication with other systems.

What are the network layers?

➢ There are 7 layers:

- ✓ Physical (e.g. cable, RJ45)
- ✓ Data Link (e.g. MAC, switches)
- ✓ Network (e.g. IP, routers)
- ✓ Transport (e.g. TCP, UDP, port numbers)
- ✓ Session (e.g. Syn/Ack)
- ✓ Presentation (e.g. encryption, ASCII, PNG, MIDI)
- ✓ Application (e.g. SNMP, HTTP, HTTPs, FTP)

OSI model

Layer	Description
Application	• To allow access to network resources
Presentation	• To translate, encrypt and compress data
Session	• To establish, manage, and terminate session • API, Sockets, WinSock
Transport	• To provide reliable process to process message delivery and error delivery
Network	• To move packets from source to destination • To provide internetworking
Data Link	• To organize bits into frames • To provide hop-to-hop delivery
Physical	• To transmit bits over a medium • To provide mechanical and electrical specifications • Coax, Fiber, Wireless, Hubs, Repeaters

Software /Upper Layers

Heart of OSI

Hardware /Lower Layers

Sender

Receiver

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Protocols supported at various levels

| Layer	Name	Protocols
Layer 7	Application	SMTP, HTTP, FTP, POP3, SNMP
Layer 6	Presentation	MPEG, ASCH, SSL, TLS
Layer 5	Session	NetBIOS, SAP
Layer 4	Transport	TCP, UDP
Layer 3	Network	IPV5, IPV6, ICMP, IPSEC, ARP, MPLS.
Layer 2	Data Link	RAPA, PPP, Frame Relay, ATM, Fiber Cable, etc.
Layer 1	Physical	RS232, 100BaseTX, ISDN, 11.

The TCP/IP model

➢The **TCP/IP** model is a more concise

framework, with only 4 layers:

- ✓Network Access (or Link)

- ✓Internet

- ✓Transport (or Host-to-Host)

- ✓Application (or Process)

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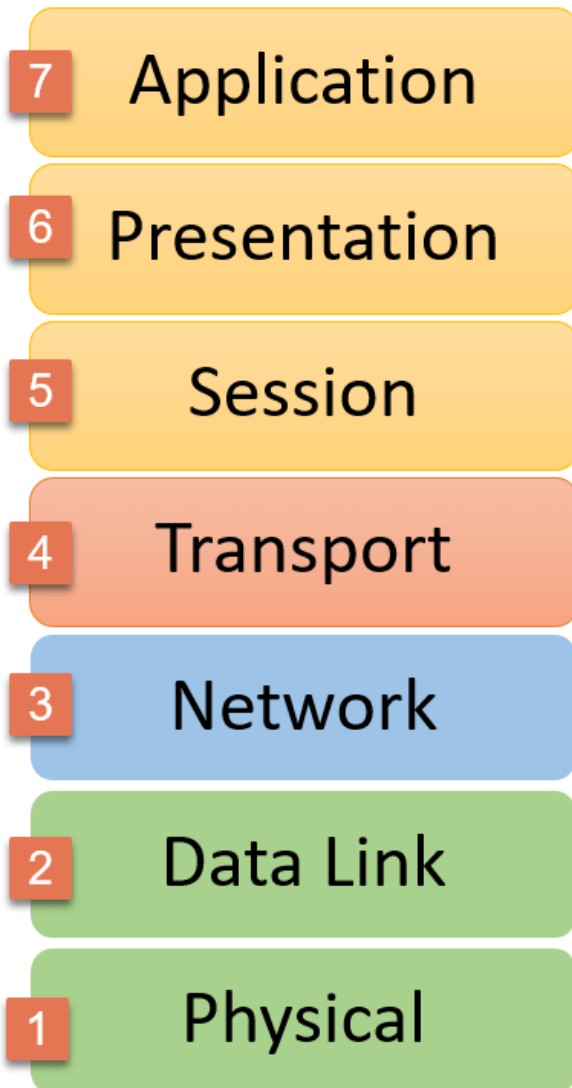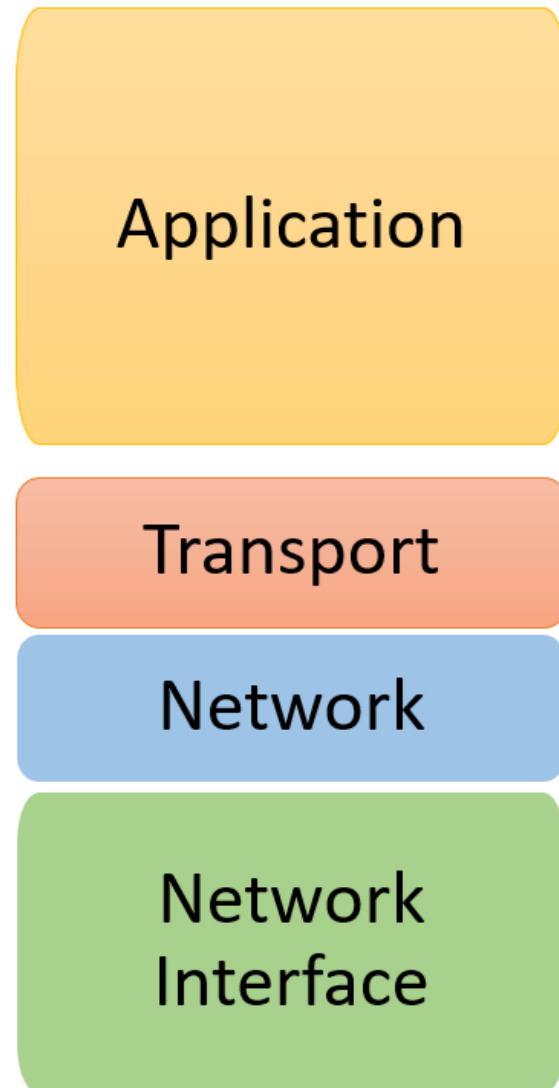
Client–Server Architecture

- is a way to structure a distributed application so that it consists client (multiple) and server (single).

- key characteristic → central point for communication.

- Server app → more complex
- Client app is simpler. (web browser)

Client–Server Architecture

- The server runs on a port (standard=80) and network IP address (need to be known) that is known to the client module.

- The server need not be configured with any information about the clients. (many->one)

- The clients only need to know the IP address of the computer on which the server is running

Client–Server Architecture

- Client server → simplicity and ease of maintenance

- It has one drawback — It does not utilize the computing power of the client computers.
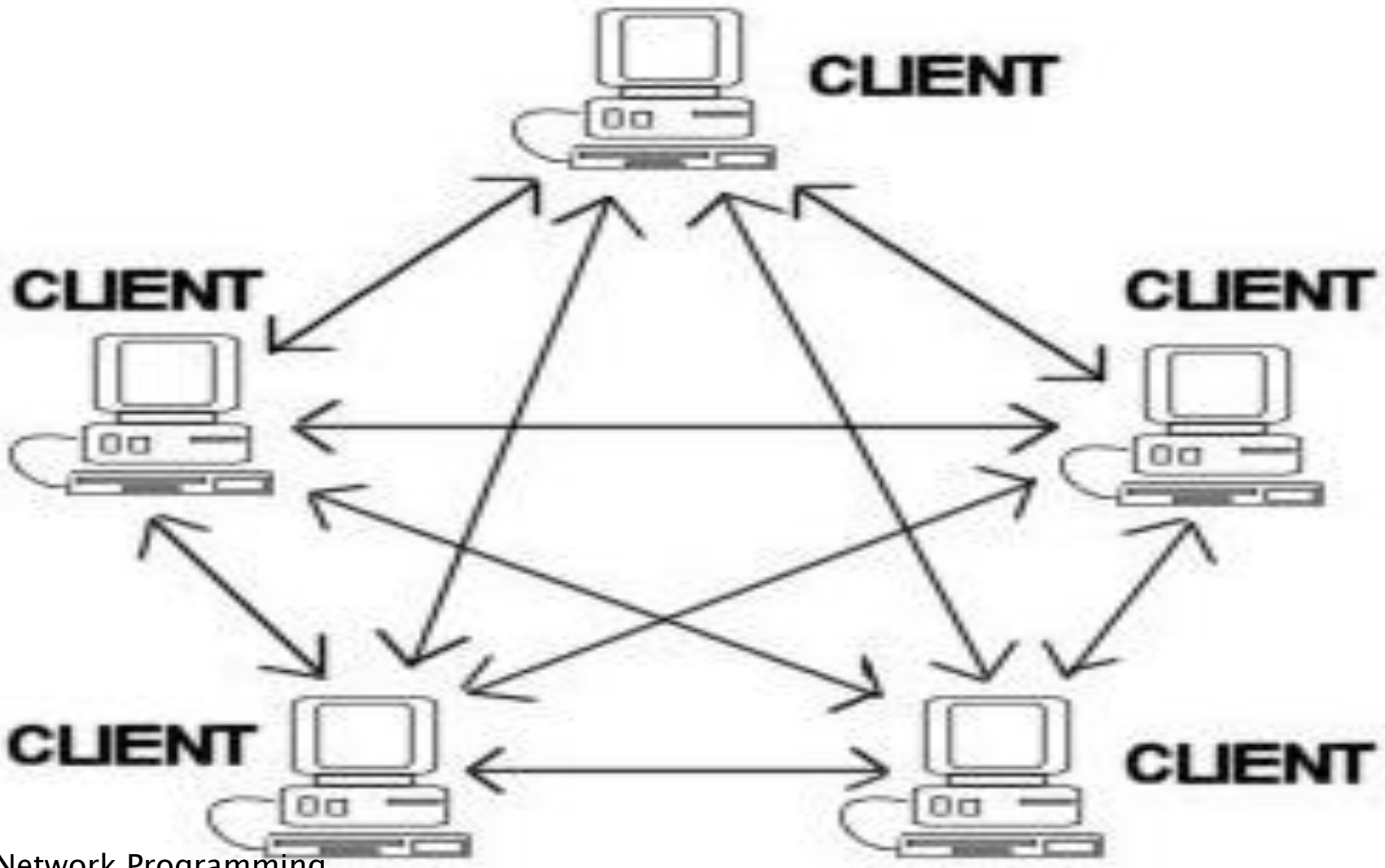
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Client–Server Architecture
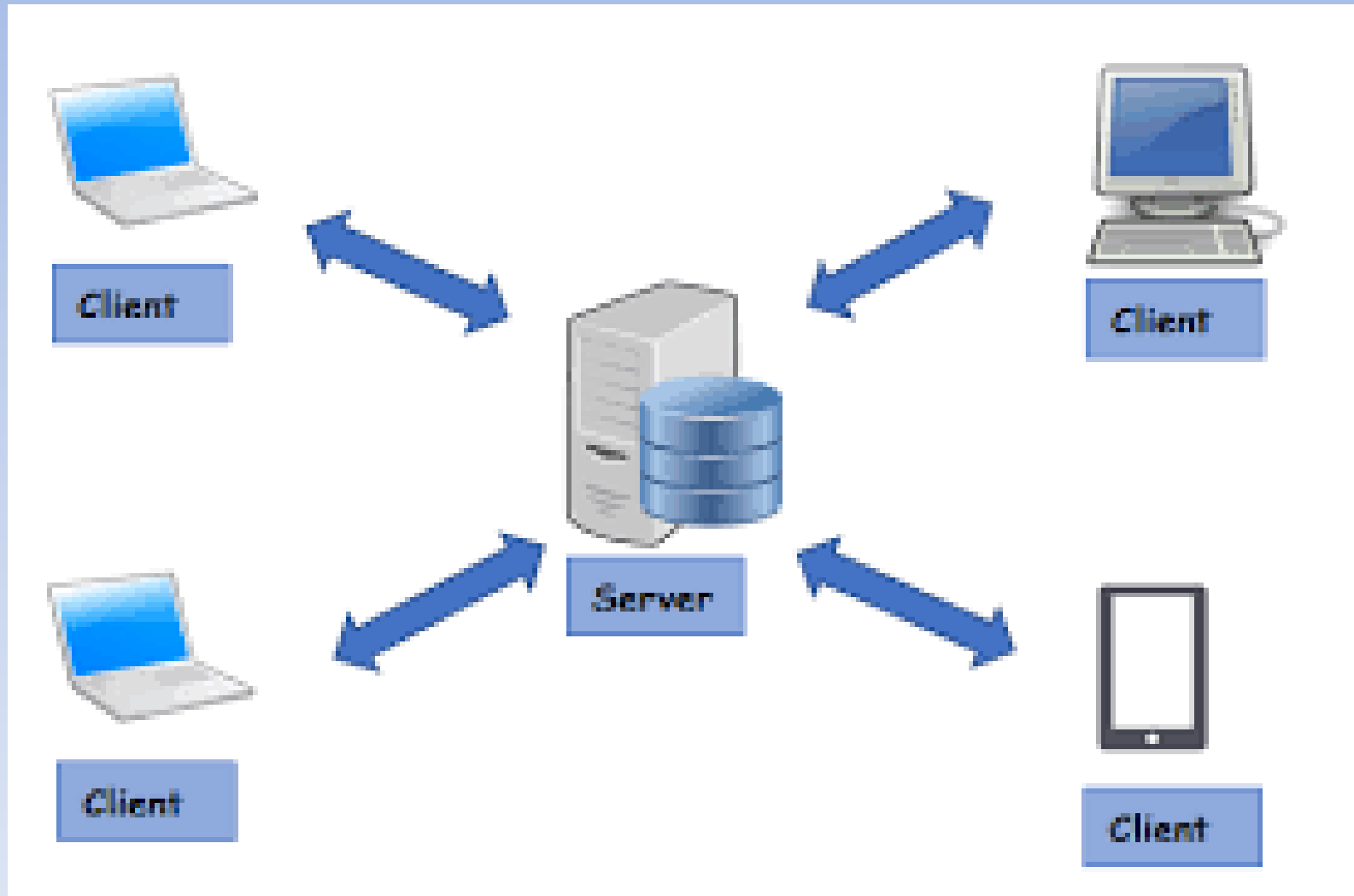
Peer-to-Peer Architecture

- More complex

- Each computer need to know the network addresses others.

- propagating changes to the different software modules is harder.

- result in much more scalable applications.

Peer–to–Peer Architecture

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Socket Programming with TCP